Saskatchewan
Agriculture, Food
and Rural
Revitalization

ADF

AGRICULTURE DEVELOPMENT FUND

FINAL REPORT

20020255

APPLIED RESEARCH AND INDUSTRY DEVELOPMENT

Funded by: The Agriculture Development Fund

April, 2004
Prepared by: Indian Head Agricultural Research Foundation (IHARF)

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Applied Research and Industry Development

Indian Head Agricultural Research Foundation

ADF Project 20020255

1) Summary

The Agri-ARM funding provided by ADF supported IHARF as it endeavors to support both Agri-ARM and SAFRR objectives. In 2003, IHARF carried out several trials and the results are presented below. Our research in 2003 focused on precision farming, swath grazing of annuals, oat and durum agronomy, minor use registration in canaryseed and the long term effects of no-till. IHARF successfully held a "Zero Till Field Day", an Annual Winter Meeting and published several newsletters. These activities help IHARF to transfer knowledge that is learned from our research to producers. In addition, technology transfer occurred at specific meetings during the year that were sponsored by other organizations.

2) Technical Report

This funding supported several projects which are presented individually below

Project #1

Cool season and warm season grasses for swath grazing

A. Summary

Swath grazing has the potential to substantially reduce winter feeding cost of cattle and improve the environment through improve manure distribution. The objective of this study is to investigate the benefits of cool season and warm season grasses for forage production to be used in a swath grazing system.

B. Background and Objectives of Study

This research project is poised to answer the much-debated issue of the adaptive quality and potential for warm season crops as an annual forage in Saskatchewan. Many questions have been raised to SAFRR staff, by producers, over the past period of drought in Saskatchewan, which species serve best for annual forage production, particularly in dry conditions. In some areas, warm season crops tended to outperform cool season crops for forage production (Vanin, unpublished). Studies conducted at the Brandon Research Centre have chronicled warm season crops advantages over cool season in dry matter production, especially for swath grazing (Byron Irvine, pers.comm.). While earlier studies evaluating old generation warm season grasses for greenfeed and silage dissuaded their production in Saskatchewan. The availability of new species and varieties of warm season grasses has reopened this question especially for use in a swath grazing system. If the provincial agricultural community is aiming to increase its cattle herd population, new innovative ideas need to be researched to provide farmers with the best information for feed production. Perennials serve as the cornerpost of the livestock production system, but annuals can provide emergency forage production or used in rotation for diversified grazing.

Objective

To evaluate forage species for adaptation, quality and yield production in annual forage and swath grazing systems.

C. Study Description

Design

Split-split plot: 2 seeding dates x 7 core varieties/species x 3 harvest dates x 4 reps.

Sites – Agri-ARM sites at Swift Current, Redvers, Canora, Indian Head, Melfort, and Scott (Seager Wheeler and Prince Albert demo only).

Main Plot: Seeding Dates

- May 15
- June 10

Sub- plots: Species (Seeding rates – **lbs/ac**)

Core treatments at all locations

1 Oat – AC Pinnacle (114)
2 Barley – Ranger (100)
3 Crown millet (20)
4 Golden German Millet – foxtail (20)

5 Mega green Sorgum-sudan grass(20)
6 Corn
7 Corn 120 lbs/N acre, hand weeded, thinned, should be in wide rows plug run or remove a row

Indian Head, Redvers and Canora

E. Siberian red millet –foxtail(20)
F. Strain R Golden German Millet
G. White wonder millet –foxtail
H. Pearl Millet

Sub-sub-plots: Harvest Dates

1st sample date - Milk dough for oats, soft dough for Barley, 2 to 3 weeks after heading for all millets and sorgum , for corn 50% milk line on kernel, if a species is not heading please call Bill and we will talk.

2nd sample date – 14 days after first sample taken, swath each individual treatment except corn after second sample is taken

3rd sample date - early December

Fertility

- 50 lbs N/ac, 20 lbs P for all treatments except for the second corn treatment

Weed Control

- Burnoff prior to seeding (0.5L/ac)

D. Results

The plots have been harvested and means generated. Statistical analysis on forage yield has been completed (Tables 1 and 2) and the quality analysis is on going. The main effect means averaged over all location and the harvest date by crop by seeding date are presented below.

Table 1. Dry matter yield from swath grazing average over all locations in 2003.

Harvest date	Dry Matter Yield Kg ha^{-1}	Least Significant Difference *P* 0.05
first	6540	250
second	6970	
Crop		
oat	5990	2220
Barley	6610	

Crown Millet	5930	
Golden german millet	6480	
Sorgum-Sudan grass	4070	
Corn - low input	9050	
Corn - high input	9180	
Seeding date		
early	6940	970
late	6580	

Table 2. Dry matter yield from swath grazing average at Indian Head in 2003

	Harvest Date			
	First		Second	
Seeding date	May 15	June 10	May 15	June 10
Crop	kg ha^{-1} of dry weight			
oat	4220	3810	6580	4630
Barley	5140	4810	6980	5540
Crown Millet	3220	3250	3810	3410
Golden german millet	4620	4280	6110	5370
Sorgum-Sudan grass	3780	2650	3590	3040
Corn - low input	5370	4700	5470	4310
Corn - high input	6230	4270	7830	4170
Siberian red millet	4810	4400	4740	5510
Strain R Golden German Millet	3360	3590	4680	4940
White wonder millet	3690	3760	4670	5120
Pearl millet	1040	1830	1210	1650
LSD0.05	1200[z]			

[z] Any means on this table that are separated by more than 1200 kg ha^{-1} are significantly different

E. Indications for Further Research

Until the quality analysis has been completed I can not make any recommendations except to carry out this experiment for another year.

F. Extension Activities

The potential of warm season grasses were discussed at the Zero Tillage Field Day 2003 in July at Indian head and will be discussed at the Soil and Crops workshop in February, 2004

Project #2

The Effect of Top-Dressed Nitrogen on Yield, Protein and Quality of Durum Wheat

A. Summary

Grain protein is an important factor in determining the quality of durum wheat (*Triticum turidum* L.). Durum markets consistently demand a protein content of 13% or higher, for which there is a premium. During the 1990's, the average protein content of durum produced on the Canadian prairies has been 12.5% or less, leaving a sizable proportion of the durum crop unsuitable for the premium market. The overall objective of this project is to determine the effect and relative efficiency of top-dressed N on grain protein, quality, yield, and economic return of durum wheat. Nitrogen at three rates (20, 40 and 60 kg N ha^{-1}) was top dressed on durum at 4 growth stages; before germination (during seeding), five leaf, flag leaf and anthesis. The study was done over three years at two locations (Indian Head and Swift Current, SK). Four cultivars were used. Increasing the rate of top dressed nitrogen increased the protein content of the durum. Applying all the nitrogen at seeding provided the most consistent increases in protein. However, when the yield potential increased during the growing season due to above normal spring and summer precipitation, protein levels in the durum seed increased when nitrogen was top dressed during the growing season.

B. Background and Objectives of Study

Durum wheat markets demand assurance of minimum quality standards. Grain protein is very important in determining durum wheat quality. Durum markets consistently demands a protein content of 13% or higher, for which industry pays a premium. Since the early 1990s, the average protein content of CWAD has been 12.5% or less, leaving a sizeable proportion of the durum crop unsuitable for the premium market. As a result other durum producing countries, mainly the United States and Australia, have increased their share of the international market at our expense. The reduction in protein content of the durum crop has been attributed to higher levels of precipitation in the Brown and Dark Brown soils zones concomitant with a decline in soil available nitrogen. In the Thin Black soil zone inadequate nitrogen supplies have also affected kernel quality, becoming a major degrading factor, with the concomitant decline in returns to the farmer. Crop management techniques that allow producers to maximize the probability of obtaining a significant protein premium and minimize the probability of their durum crops being downgraded will have a significant effect on their net return.

The objective is to determine effect and relative efficiency of top-dressed N on yield, grain protein, quality and economic return of durum wheat.

C. Study Description

Cultivars of CWAD wheat will be grown with a basal N application at seeding that will provide the crop with 75% of the available N (soil NO_3-N plus fertilizer N) required to achieve maximum yield and protein. Top-dressed N treatments will be superimposed on this basal N application and will consist of a full factorial combination of the following factors:

I) Nitrogen application rates: 20, 40, and 60 kg N ha^{-1}.

II) Time of topdressing: five-leaf, flag-leaf, and anthesis growth stages

III) CWAD cultivars: AC Avonlea, AC Morse, AC Navigator, Kyle.

As control for each cultivar, a set of plots will be fertilized at seeding with the basal N application plus 0, 20, 40, and 60 kg N ha^{-1}.

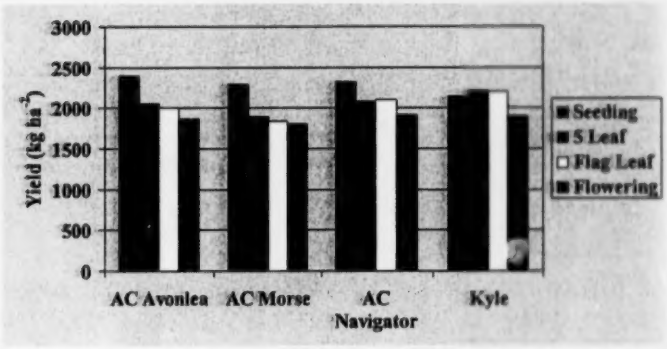
Locations: Indian Head and Swift Current, SK

All plots will receive a blanket application of P, K, and S to ensure these nutrients will not limit crop growth. The experiment will be replicated four times. This design will allow us to determine the direct effect of top-dressed N on grain yield protein and quality parameters, and to assess the efficiency of top-dressed N relative to a similar amount of N applied at seeding.

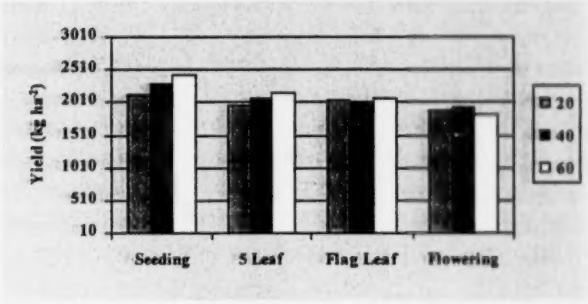
D. Results

The study has been completed and a full report should be ready by the summer of 2004. The figures presented below indicate the response that can be obtained from durum in a wheat year on soil with low organic matter.

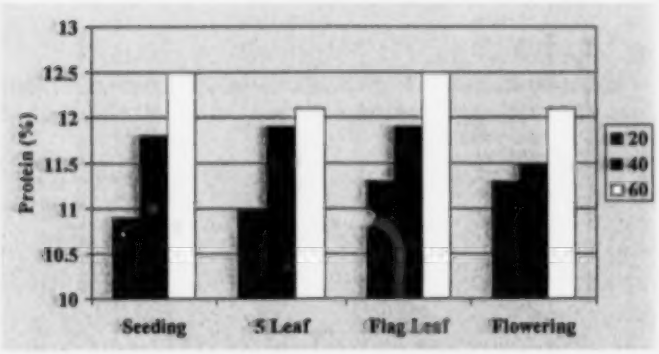
N Timing on Yield
Swift Current 2002



N Timing and Rate on Yield
Swift Current 2002



N Timing and Rate on Protein Swift Current 2002



E. Indications for Further Research

The next step is to determine how much of an increase in yield potential do you need on a specific soil type to justify top dressing nitrogen

F. Extension Activities

Presentations

a. Improving My Farms Durum Quality with Crop Rotation & Fertilization. CWB Durum Challenge III, The Changing Marketplace Palliser Pavilion, Kinetic Park Swift Current, Saskatchewan. Dec 12, 2002

b. Canaryseed, Oat and Durum Research, IHARF Winter Seminar & Annual Meeting, Indian Head, Jan 22, 2003

c. Durum and Oat and Canary Research, Zero Tillage Field Day 2003, Indian Head, July 22, 2003

d. **May, W.E., Selles, F., Fernandez, M.R. and Lafond, G.P.** The effect of Top-dressed nitrogen on grain yield, protein, quality and economic return of durum wheat on the Canadian Prairies. Agronomy Abstracts. American Society of Agronomy Annual Meetings. November, 2003.

e. Presentation of "The effect of Top-dressed nitrogen on grain yield, protein, quality and economic return of durum wheat on the Canadian Prairies" at Soil and Crops - 2004

Written articles

A. Improving Durum Quality and Profitability Through Nitrogen and Disease Management, Zero Tillage Field Day 2003, Indian Head, July 22, 2003

B. Top Dressing Durum to Manage Protein, IHARF Newsletter, Fall 2003

All plots will receive a blanket application of P, K, and S to ensure these nutrients will not limit crop growth. The experiment will be replicated four times. This design will allow us to determine the direct effect of top-dressed N on grain yield protein and quality parameters, and to assess the efficiency of top-dressed N relative to a similar amount of N applied at seeding.

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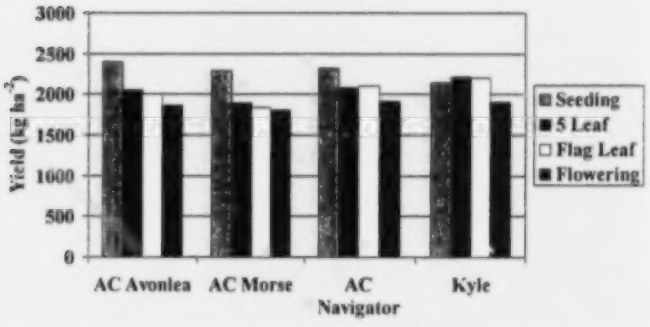
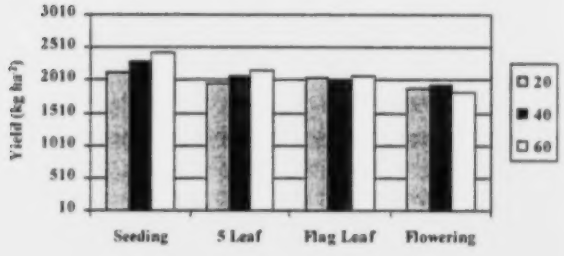
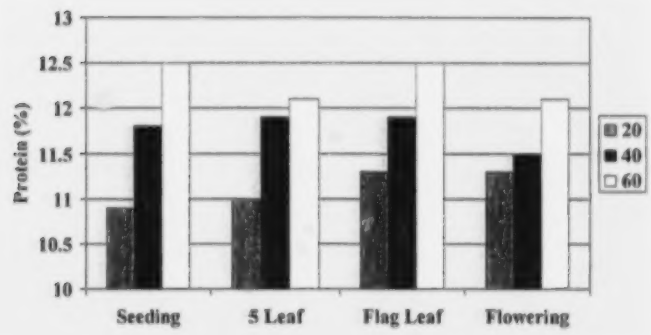


N Timing and Rate on Yield
Swift Current 2002



N Timing and Rate on Protein Swift Current 2002



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d. **May, W.E., Selles, F., Fernandez, M.R. and Lafond, G.P.** The effect of Top-dressed nitrogen on grain yield, protein, quality and economic return of durum wheat on the Canadian Prairies. Agronomy Abstracts. American Society of Agronomy Annual Meetings. November, 2003.

e. Presentation of "The effect of Top-dressed nitrogen on grain yield, protein, quality and economic return of durum wheat on the Canadian Prairies" at Soil and Crops - 2004

Written articles

A. Improving Durum Quality and Profitability Through Nitrogen and Disease Management. Zero Tillage Field Day 2003. Indian Head. July 22. 2003

B. Top Dressing Durum to Manage Protein. IHARF Newsletter. Fall 2003

Project #3
Tolerance of Canaryseed to Puma Super

A. Summary

Very little injury occurred except when Puma Super was not tank-mix. When Puma Super was not tank mixed reduction in growth and delays in maturity were observed. Under the drought conditions which occurred at Indian Head in 2003 now yield reduction was observed.

B. Background and Objectives of Study

Avenge is the only herbicide currently registered for wild oat control in canaryseed. Puma Super is being tested as a candidate for grassey weed control in canaryseed.

C. Study Description

A four rep RCBD design was used

Canaryseed - Tolerance

1.	Untreated - weed free	
2.	Puma Super (fenoxaprop-p-ethyl)	92 Post-E
3.	Puma Super	184 Post-E
4.	Puma Super + Buctril M	92 + 560 Post-E
5.	Puma Super + Buctril M	184 + 1120 Post-E
6.	Puma Super + Buctril M + Adapt	92 + 560 + 1% v/v Post-E
7.	Puma Super + Buctril M + Adapt	184 + 1120 + 1% v/v Post-E
8.	Puma Super + Curtail M	92 + 660 Post-E
9.	Puma Super + Curtail M	184 + 1320 Post-E
10.	Puma Super + Curtail M + Adapt	92 + 660 + 1% v/v Post-E
11.	Puma Super + Curtail M + Adapt	184 + 1320 + 1% v/v Post-E
12.	Avenge + MCPA Ester	700 + 560 Post-E

Sites: Scott, Saskatoon and Indian Head

apply at the 1-tiller stage (3-4 leaf stage) of crop prior to the appearance of the 2nd tiller

D. Results

able 1. Results of testing Puma Super at the 5 leaf stage of Canaryseed in 2003 at Indian Head

		Vegetative injury				Height	Heading	Yield	Kernel Weight
		6 days	12 days	23 days	40 days				
		%	%	%	%	cm	days	kg/ha	g/1000 kernels
CHECK,WEED FREE		0f	0f	0d	0c	57	53	914	7.6
Puma Super (fenoxaprop-p-ethyl)	92 Post-E	8de	22b	23b	18b	53	58	881	7.5
Puma Super	184 Post-E	13bc	33a	32a	30a	55	60	788	7.7
Puma Super + Buctril M	92 + 560 Post-E	10cd	10cd	5cd	5c	53	55	855	7.9
Puma Super + Buctril M	184 + 1120 Post-E	15ab	13c	7c	3c	57	54	975	7.5
Puma Super + Buctril M + Adapt	92 + 560 + 1% v/v Post-E	15ab	10cd	3cd	5c	55	55	825	7.8
Puma Super + Buctril M + Adapt	184 + 1120 + 1% v/v Post-E	18a	13c	3cd	3c	54	55	894	7.9
Puma Super + Curtail M	92 + 660 Post-E	5e	10cd	7c	5c	51	54	737	7.7
Puma Super + Curtail M	184 + 1320 Post-E	8de	7de	0d	2c	59	54	820	8
).Puma Super + Curtail M + Adapt	92 + 660 + 1% v/v Post-E	8de	10cd	3cd	5c	56	55	688	7.7
.Puma Super + Curtail M + Adapt	184 + 1320 + 1% v/v Post-E	18a	15c	5cd	3c	53	55	657	7.7
!.Avenge + MCPA Ester	700 + 560 Post-E	5e	2ef	0d	0c	60	54	954	7.9
		lsd = 4.9	lsd =6.2	lsd =6.2	lsd =7.5	NS	NS	NS	NS

E. Indications for Further Research

Further study of Puma Super is required.

F. Extension Activities

Presentations

a. Canaryseed, Oat and Durum Research, IHARF Winter Seminar & Annual Meeting, Indian Head, Jan 22, 2003
b. Canaryseed: Yield Variability and Herbicides, Rosser, MB, March 6, 2003
c. Canaryseed: Yield Variability and Herbicides, Eston, SK, March 18, 2003
d. Canaryseed: Yield Variability and Herbicides, Regina, SK March 20, 2003
e. Canaryseed: Yield Variability and Herbicides, Lampman, SK, March 27, 2003
f. Durum and Oat and Canary Research, Zero Tillage Field Day 2003, Indian Head, July 22, 2003
g. Canaryseed Research at the Indian Head Research Farm. Canaryseed Tour, Indian Head, July 30, 2003
h. Maximizing Your Canaryseed Yields, Starbuck Crop Production Seminar, Starbuck, MB, December 4th, 2003

Written articles

A. Canaryseed: Agronomic Recommendations, Zero Tillage Field Day 2003, Indian Head, July 22, 2003
B. Update on Current Research Projects, IHARF Newsletter, Fall 2003

Events - Participated in the founding meeting of the Canaryseed Association of Canada

Project #4
Role of Self Seeding Medics in a Continuous Grain System

A. Summary

Self seeding medics have the potential to reduce crop inputs with out reducing yield. The objective of this study is to examine the performance of medic in a winter wheat-oat-flax rotation. The first year of the study has been completed.

B. Background and Objectives of Study

Self-seeding cover crops such as medic offer a flexible, low risk, home-grown way to improve farm productivity. In addition to the crop's nitrogen-fixing benefits, the study will investigate medic's potential to stabilize soil salinity, reduce excess water problems, control volunteers and post-harvest weeds, and allow for late-season grazing. Medic and other legumes represent untapped potential for farmers to improve their bottom line. Approximately 10 million acres in the Prairie region can support significant legume plant growth during, and especially after grain crop harvest. And adoption of no-till has increased the late-season soil water supply. Four years of previous research in Manitoba has shown that cover crops in continuous grain systems consistently reduce the need for nitrogen (N) fertilizer by 10 to 65 lbs./acre/year. Assuming an N fertilizer cost of $0.25 to $0.30 a pound, this could mean a value of millions annually for prairie farmers in the black soil zone. Medic is a self-regenerating, low-growing legume that farmers can underseed to wheat and other cereals. The objective of this study is to examine the performance of medic in a winter wheat-oat-flax rotation.

C. Study Description

Split Split plot with medic oats as the main effect and crop as the sub plot and nitrogen rate as the sub-sub plot

Plot Size: 35 feet x 13 ft

Reps: 3

Treatments:

I)Medic	1) No Medic
	2) Medic
II)sub-plot: Crop	1) Winter Wheat
	2) Flax
	3) Oat
IV)subsub-plot: Nitrogen Rate	
	1) 20% of required N
	2) 60%
	3) 100%

D. Results

The medic has been established. The first year has been completed and the fall wheat was planted. The flax and oats will be seeded gain in the spring.

E. Indications for Further Research

It is too early in the study to determine the next direction research should go.

F. Extension Activities

The potential of self seeding medic were discussed at the Zero Tillage Field Day 2002, July 23, 2002

Project #5
Effects Of Nitrogen Fertility, Management Zones, Crop Plant Population, Weeds And Diseases On Canola Yields Using A Field Scale Approach

1. Executive Summary:

A three year Precision Farming study was conducted in Indian Head, SK. to look at the effects of nitrogen fertility, management zones, crop plant population, weeds and diseases on canola yields using a field scale approach. The results from the study demonstrates that yield variability was greatest due to different environmental conditions encountered each year, management zones, diseases and weed pressures. This study highlights the importance of variable rate fertilization programs and crop monitoring to maximize field profitability.

2. Acknowledgments:

IHARF would like to acknowledge the in-kind sponsorship of New Holland North America and Markusson Country for supplying the necessary farm equipment needed for this research project, as well as Simplot Canada for their in-kind support for liquid fertilizer, SCDC for their financial support for the disease survey and the rest of the IHARF Precision Farm sponsors listed on our web site : http://paridss.usask.ca/precisionfarm.
Furthermore, IHARF would like to acknowledge Dr. Prakash Basnyat, Dr. Brian McConkey and Dr. Guy Lafond for their unprecedented expertise in the data analysis for this project and Chris Omoth for his technical support.

Background: The overall objective of the Precision Farming Project initiated by Indian Head Agricultural Research Foundation (IHARF) in 1999 is to determine cost effective ways of assigning management units to a field and to adjust production practices according to these management units. The project is comparing a variety of methods of assigning management units against detailed soil samples taken on a one-acre grid. Presently, the high cost of assigning management units using extensive soil sampling makes this approach uneconomical. Some of the alternative approaches under study involves measurements with an EM38 (soil salinity meter), digital elevation map, yield map, remote sensing using the non differentiated vegetative index (NDVI), aerial black and white and infra-red photographs, general soil survey and ground based hyperspectral measurements.

Objective:

The objective of this project was to collect information on the spatial variability of crop plant populations, weeds and plant diseases during the 2000, 2001 and 2002 growing season in order to determine the effect of these biotic factors on the final grain yield of canola as part of a variable rate nitrogen program on the IHARF Precision Farm.

3. Details of Experimental procedures

Introduction:

Canola yields are affected by year to year variations in growing season conditions but also by many biotic factors on a field scale basis. The best way to determine the effects of the biotic factors on canola final yield is to look at them on a field scale basis. In 1998, IHARF started a Precision Farming Project on 308 acres of land. In 1998 the farm was divided in 8 – 38.5 acre fields. A crop rotation of spring wheat- canola-spring wheat – field pea was implemented. Furthermore, 308 markers were geo-referenced and inserted in the ground for data collection purposes in the spring of 1998. In 2000, a variable rate fertility program for nitrogen was implemented for the wheat and canola fields based on a checker board grid pattern that allowed replication of several N rates in each of the management zones predetermined using satellite images.
Weeds, plant counts and disease rating were done at every marker and recorded on paper. Using a Geographical Information systems (GIS) it was then possible to create layers of information for each data set collected at every marker. In the fall, each fields were harvested with a TR99 combine equipped with a yield monitor and GPS antenna in order to create yield maps.
By overlaying all the data layers into a GIS , it was possible to extract the information necessary to determine which of the biotic factors had the greatest effect on final grain yield in canola.

Materials and Methods

A- Seeding:

Seeding was done with a 33 foot Flexicoil 5000 series air drill, equipped with double shoot stealth openers on 12 inch spacing. The seed and granular fertilizer (P and K) rates were controlled using a Flexicoil 2340 series air cart. The Liquid nitrogen was metered and delivered by a Pattison liquid wagon retrofitted with a Flexicoil 67 Sprayer XL rate controller .

In 2000, the Flexicoil TASK controller was used to read the prescription maps and transfer the rate information to the rate controller mounted on the liquid wagon.
In 2001 and 2002, a Compac IPAQ handheld computer , loaded with the Farm Works Software (Farm Site Mate) was used to read the liquid nitrogen prescription maps.

As applied maps were created on-the -go at seeding as the computer system would send information to the rate controller and record the feedback simultaneously. As Applied Maps were created for 2000 and 2002. In 2001 the computer system used could not record as applied information thus only the nitrogen rates of the prescription maps were used in the analysis.

B- Spraying:

Each canola field was sprayed for weeds after the weed survey was done using a 90 foot boom Flexicoil 67 XL High Clearance Sprayer. A detailed list of dates of application, rates and chemicals can be found in Appendix A.

C- Harvest:

The canola crop was swathed each year prior to harvest with a 25 foot swather. Each swath was harvested using a New Holland TR99 combine equipped with an Agleader PF3000 yield monitor and GPS system. In 2000 record yields were achieved due to favorable growing conditions. However in 2001 and 2002 the dry growing conditions lowered the yields considerably. Furthermore, in 2002, the yield data was not good as extreme wind conditions blew the canola swaths thereby affecting yield results.

D- Management Zone delineation:

In 2000, a Normalized Vegetation Index map (NDVI) was created for the entire Precision Farm using the Red (0.63 nm - 0.69 nm) and Near-Infrared (0.76 nm - 0.9 nm) bands of Landsat-7 TM images acquired from the previous two years. NDVI is an indirect measure of crop biomass and is strongly correlated to final grain yield (Basnyat et al (2003). We were able to define three (3) distinct management zones based on NDVI: Low , Medium and High Biomass (Appendix B, Figure 9).
The management zones were delineated using an unsupervised classification or clustering method to identify naturally occurring clusters in NDVI using IDRISI32 image analysis software. As a starting point, five classes were delineated and checked for the significant difference in mean NDVI using least significant difference (. SD) at p=0.05. If there were two or more zones whose mean NDVI were not significantly different, clustering was redone with one less zone. If all zones had significantly different NDVI, the clustering was redone with one more zone. We assumed that the optimal number of zones was equal to the maximum number of statistically significant individual zones based on zonal mean NDVI. Zones were delineated separately for each Landsat TM Imaging and averaged together to obtain a complete management zone map for the entire farm. (for more details refer to Basnyat et al. 2003)

For pictures of seeding implement, management zones, prescriptions, as applied and yield maps refer to Appendix B.

E- Data collection:

a) Plant counts:

Plant counts were done 2 weeks after crop emergence. Four (4) counts were done at each geo-referenced marker using the one meter row method, recorded and expressed as plants per meter square.

b) Weeds count:

Weeds count were done 3 to 4 weeks after seeding and just prior to the in-crop herbicide application around each marker. Four counts using a 0.25 cm^2 quadrat, were recorded and converted to a per meter squared (m^2) value. Each weed specie was identified and recorded separately. For the analysis purpose of this report only a total weed density, broadleaf weed and grassy weed density were used. Broadleaf weed densities included the annual weeds stinkweed, lambs quarter, flixweed, kochia, and the perennial weeds Dandelion and Canada Thistle. Grassy weeds included annuals such as volunteer wheat, green foxtail, wild oat and barn yard grass.

c) Disease rating:

Canola plants were rated for disease severity (foliar, stem, and pods, on a whole plant basis) at 4 locations around each geo-referenced marker using the Horsfall-Barratt disease rating (0-11) scale in 2001 and 2002. Alternaria pod spot (*Alternaria* spp.) was also rated for disease severity at 4 locations around each marker using the Horsfall-Barratt rating scale. Blackleg (*Leptosphaeruia maculans*) and sclerotinia (*Sclerotinia sclerotiorum*) lesions that occurred on any part of the canola stem were assessed separately from basal stem cankers. The number of plants with stem or basal lesions of both blackleg and sclerotinia were noted between 2 x 24 ft. (length of distance between swaths). The prevalence of staghead (*Albugo candida*) and aster yellows (mycoplasma) were also noted. Canola plants were rated after the crop had been swathed.

d) Elevation data collection:

In the fall of 2000, elevation data for the entire Precision Farm was collected using a Trimble Real Time Kinematic (RTK) system. Elevation data points were measured on a 3 meter by 3 meter grid at a sub-centimeter accuracy.
The RTK system consisted of a base station positioned in the field over a known geodetic point, and a roving station mounted on a vehicle. As the vehicle traveled in the field, elevation data points were recorded and stored on the on-board computer.

F- Data analysis:

a) Data preparation:

For all three years, elevation, yield, weeds, plant counts and disease ratings data were kriged on a per field basis using GS+ software. The kriging method allowed the creation of a smooth interpolated surface for each parameter measured. The liquid nitrogen "As Applied" maps for 2000 and 2002 were used "as is" to have an accurate nitrogen applied value per fields.
Each map layer were imported into ArcView GIS program for overlay and data analysis purposes.

The kriged elevation data was transformed into a digital elevation map in ArcView. Using the "slope calculation" module of Spatial Analyst, a "Slope" map layer was created and used in the analyses.

b) Data extraction:

In 2000 and 2001, a 1 acre grid was used to extract and calculate an average value for each parameters in each cell of the grid. As a result, there were 40 averages per field per data layer available for statistical analysis.
In 2002 a 0.25 acre grid was used to extract and calculate an average value for each parameter.

c) Data analysis:

Data extracted from each grid cell was pooled for each year and a correlation matrix was developed for all the parameters measured to identify which parameter had a strong association with final grain yield of canola each year.
Furthermore, mean values for each variable were extracted per management zones and statistically compared using an analysis of variance (ANOVA)with the SAS program. Stepwise multiple regression analyses was also used each year to determine the contribution of each parameter to canola yield.

4. Results

Year 2000:

Table1: 2000 Correlation Matrix

	Norm.Yield	N fert	Plants/ m^2	Slope	Weeds/m^2	Grasses/m^2	Broadleaf/ m^2
Norm. Yield	1						
N fert	0.67*	1					
Plants/m^2	-0.21	-0.14	1				
slope	-0.34*	-0.47*	0.16	1			
weeds/m^2	0.34*	0.21	0.12	-0.29	1		
Grasses/m^2	0.25	0.22	0.4*	-0.46*	0.84*	1	
Broadleaf/m^2	0.22	0.02	-0.43*	0.25	-0.05	-0.28	1

(* Significant at the 5% level)

In 2000 the canola yields were very good. An average of 55 bushels per acre was obtained for the two fields at the Precision Farm. In order to pool yield data for two different fields for correlation purposes, yield data was normalized by using this formula: **((yield data point - mean)/standard deviation).** The resulting yield values ranged between -4 to +4.

A positive correlation of 0.67 (Table 1) between normalized yield and nitrogen fertility suggested that the nitrogen fertility treatments had a positive effect on yields where yields increased as nitrogen fertility increased (Figure 1).

However, a negative correlation between canola plant stand (plants/m2) and yield existed due to the significant difference in plant population between the fields and nitrogen rates (Table 2). Furthermore, plant numbers per meter squared were not significantly affected by management zones but mostly by the effects of field. (Table 3).

Figure 1: Effects of Nitrogen treatments on Canola yield.

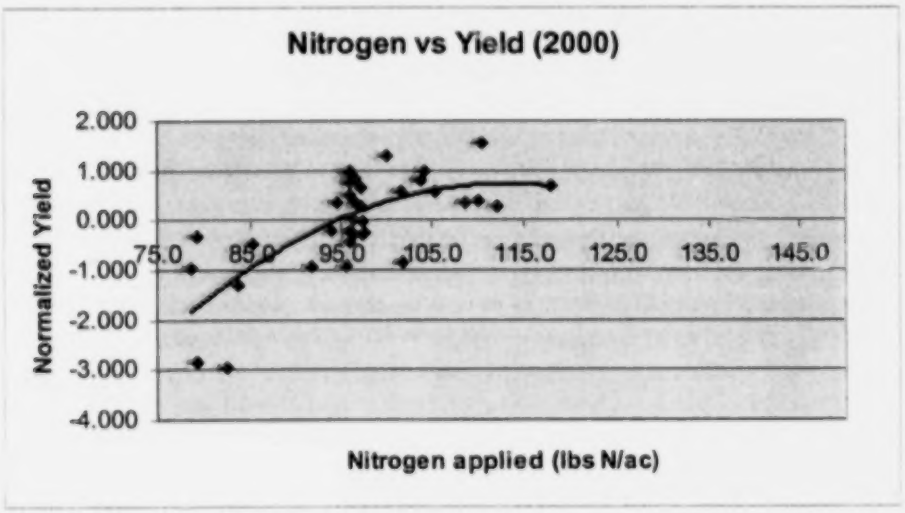

Table 2. The effects of nitrogen rates and field on the number of plants per meter square in canola in 2000.

N Rate (kg/ha)	Field #		Mean
	2	7	
84	78	122	100
109	79	114	96
132	73	97	85
Mean	78	109	
N rate *; Field *; s.e.=8.5 cv=8.9%			

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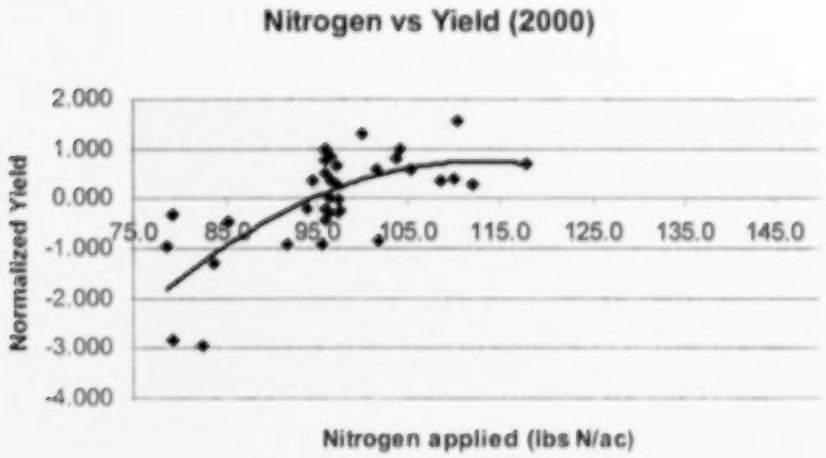

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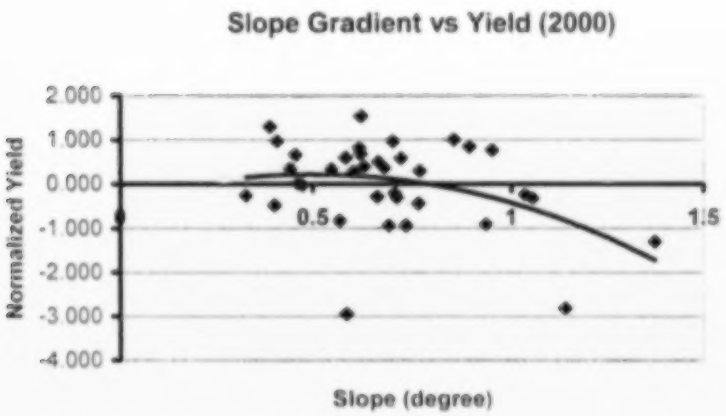
109	79	114	96
132	73	97	85
Mean	78	109	
N rate *; Field *: s.e.=8.5 cv=8.9%			

Table 3. The effects of field and Management Zones on the number of plants per meter square in Canola in 2000.

Mgt Zone	Field #		Mean
	2	7	
1 (low)	79	118	107
2 (medium)	77	104	88
3 (high)	-	103	103
Mean	78	109	
Mgt Zone ns; Field *; s.e.=8.5 cv=8.9%			

Slope gradient had a negative impact on yields. As slope gradient increased, yields decreased which explained the negative correlation of -0.24 found between slope and normalized yield (Figure 2). Similar results were found by Pennock et al (2001) in Hepburn, SK in a hummocky landscape where higher yields were highest in concave, lower lying areas of the field and lower yields in the mid-slope to shoulder areas.

Figure 2: Effect of Slope gradient on Canola yield.



Furthermore, management zones significantly affected yields and the higher observed yields were closely associated to high NDVI areas or high biomass areas and lower yields associated with low NDVI values or low biomass zones (Table 4). These results proved that the technique used for zone delineation from Landsat-7 imagery were accurate.

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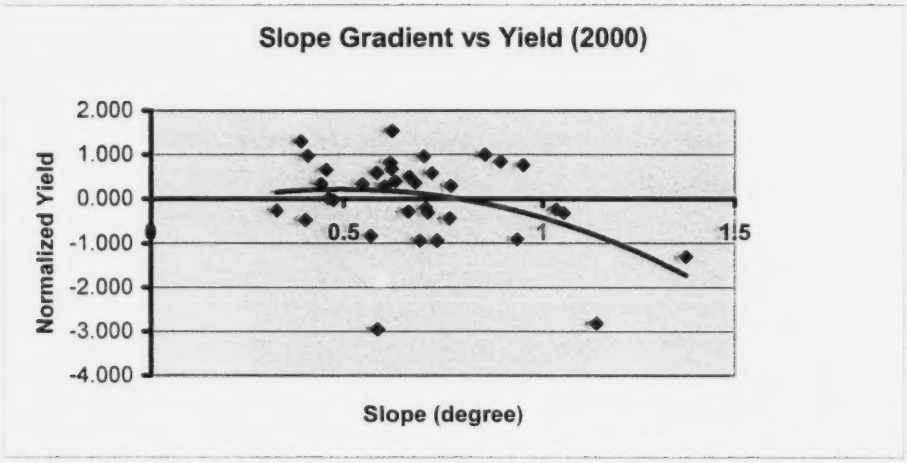

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Table 4. The effects of Field and Management Zones on the grain yield (kg/ha) of Canola in 2000.

Mgt Zone	Field #		Mean
	2	7	
1 (low)	1966	2445	2302
2 (medium)	2245	2597	2389
3 (high)	-	2695	2695
Mean	2192	2563	
Mgt Zone **; Field **; s.e.=189; cv=7.9%			

As weed counts were done before the in-crop weed control program, correlation between weed counts and normalized yield explained the effectiveness of the herbicides used to control specific weed pressure in the field. A positive correlation of 0.32 was found between total weed density count and yield which would confirmed that weed pressure was under control during the season and the weeds had little effect on crop final yield. This finding is further confirmed when correlating broadleaf weeds and grassy weeds to yield with correlation values of 0.25 and 0.22 respectively.

Overall, in 2000 yield were mostly affected by the differences in field conditions (43%), nitrogen rates (14 %) and weeds (0.1 %) as shown by the stepwise multiple regression analysis summarized in Table 5.

Table 5. Summary of Stepwise regression to determine the factors that have the greatest effects on yield of canola based on field scaled measurements in 2000.

Variable	Partial R-square	Model R-square	Pr>F
Field	0.43	0.43	<.0001
N Rate	0.14	0.57	0.003
Broadleaf weed #s per m^2	0.06	0.63	0.037
Total weed #s per m^2	0.04	0.67	0.05

Year 2001:

Year 2001 was the driest year of the three year study at Indian Head, SK (Table 6). Canola yields were greatly affected by the lack of moisture but yielded on average 30 bushels per acre for the two fields at the Precision Farm.

Table 6: Monthly Precipitation accumulation (mm) in Indian Head, SK for the 2000, 2001 and 2002 growing seasons.

	2000	2001	2002	Long term mean
May	68.2	1.6	17.6	44
June	105.2	29.4	115.4	88
July	45.6	41	48.6	49
August	63.4	13.2	98	44
Total	282	204	279	225

Nitrogen fertility treatments did not work as effectively due to the lack of moisture during the growing season as represented graphically in figure 3. Furthermore, the poor correlation between yield and nitrogen fertility would support that (Table 7).

Figure 3: Effects of Nitrogen treatments on Canola Yield

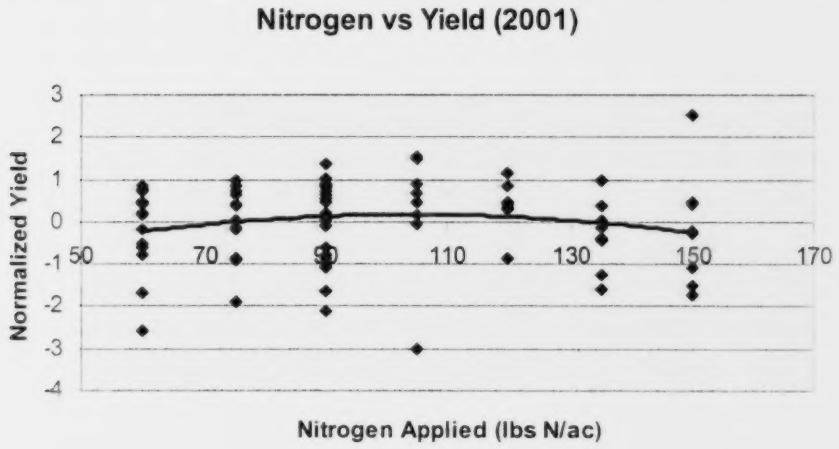

Table 7: 2001 Correlation Matrix

	Yield	N Fert	Plnts/m2	HB Rating	POD Rating	Sclerotinia Stem rating	Sclerotinia Basal rating	BlackLeg Stem rating	Blackleg Basal rating	Slope	Weeds/m2
Yield	1										
N Fert	0.005	1									
Plnts/m2	0.12	-0.14	1								
HB Rating	0.23*	0.02	0.31*	1							
POD Rating	0.27*	-0.08	0.22	-0.22	1						
SS rating	0.32*	-0.03	-0.07	0.24*	-0.12	1					
SB rating	0.29*	-0.04	0.14	0.57*	-0.13	0.17	1				
BL Rating	-0.32*	0.03	0.24*	0.1	-0.1	-0.16	0.02	1			
BL Rating	-0.08	-0	0.17	0.18	-0.28*	-0.007	0.03	0.48*	1		
Slope	-0.37*	0.15	-0.37*	-0.18	-0.47*	-0.18	-0.18	0.032	-0.09	1	
Weeds/m2	0.26*	-0.09	-0.08	0.37*	-0.22	0.39*	0.41*	-0.1	0.21	-0.22	1

(* significant at the 5% level)

Table 6: Monthly Precipitation accumulation (mm) in Indian Head, SK for the 2000, 2001 and 2002 growing seasons.

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May	68.2	1.6	17.6	44
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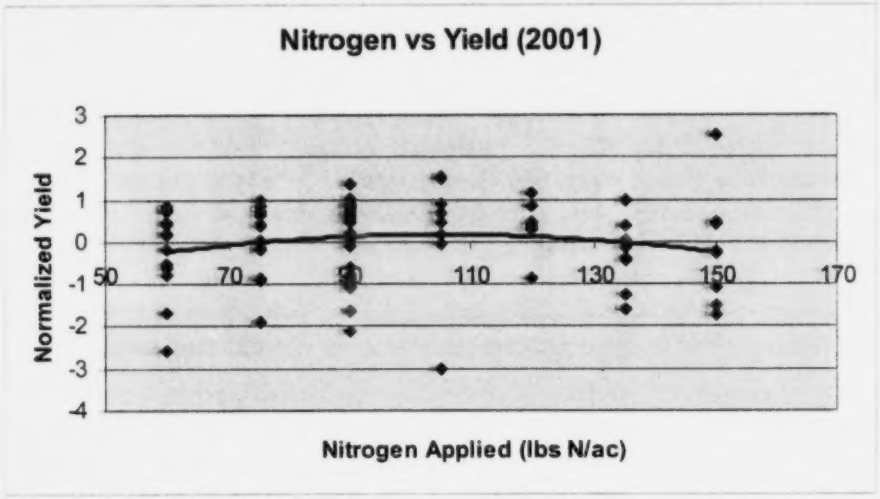

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Yield	1										
N Fert	0.005	1									
Plnts/m2	0.12	-0.14	1								
HB Rating	0.23*	0.02	0.31*	1							
POD Rating	0.27*	-0.08	0.22	-0.22	1						
SS rating	0.32*	-0.03	-0.07	0.24*	-0.12	1					
SB rating	0.29*	-0.04	0.14	0.57*	-0.13	0.17	1				
BL Rating	-0.32*	0.03	0.24*	0.1	-0.1	-0.16	0.02	1			
BL Rating	-0.08	-0	0.17	0.18	-0.28*	-0.007	0.03	0.48*	1		
Slope	-0.37*	0.15	-0.37*	-0.18	-0.47*	-0.18	-0.18	0.032	-0.09	1	
Weeds/m2	0.26*	-0.09	-0.08	0.37*	-0.22	0.39*	0.41*	-0.1	0.21	-0.22	1

(* significant at the 5% level)

With the use of a different on-board computers we achieved a more consistent plant stand for both fields. However actual plant population was much lower than target plant population of 40 to 55 plants per meter square. However, a small positive correlation between plant density and yield was found. Furthermore, the effects of field and management zones on plant population were not significant (Table 8), and plant population was not affected by nitrogen treatments nor field effects.(Table 9).

Table 8. The effects of field and management zones on the number of plants per meter square in canola in 2001.

Mgt Zone	Field #		Mean
	3	8	
1 (low)	32	31	31
2 (medium)	33	34	33
3 (high)	32	33	33
Mean	32	31	
All factors not significant; cv=12.7%			

Table 9. The effects of nitrogen rates and field on the number of plants per meter square in canola in 2001.

N Rate (kg/ha)	Field #		Mean
	3	8	
60	33	33	33
75	33	32	33
90	32	32	32
105	29	31	30
120	35	29	32
135	34	27	31
150	32	30	31
Mean	32	31	
All factors not significant; cv=12.7%			

Despite the dry conditions, yield varied significantly between management zones and field (Table 10) where higher yield were found in the high biomass zone and lowest yield in the low biomass zone. These findings are very similar to the year 2000 which confirmed that the management zones previously delineated were similar between both years.

Table 10. The effects of field and management zones on the grain yield (kg/ha) of canola in 2001.

Mgt Zone	Field #		Mean
	3	8	
1 (low)	1747	1577	1621
2 (medium)	2076	1725	1998
3 (high)	2127	2004	2127
Mean	1986	1599	
Mgt Zone **; Field **; s.e.=201; cv=11.2%			

Weed control was also effective during the 2001 growing season as a positive correlation between total weed density and normalized yield of 0.29 existed. However, due to the drought conditions total weed density was greatly reduced as compared to the 2000 growing season.

Disease ratings were done before harvest when the canola plants were swathed. Horsfall-barratt and Pod ratings showed a positive correlation with yield. However when the raw data was looked at closely, the ratings were very low for both fields. Therefore , disease pressure did not affect canola yield dramatically.

However, when correlating disease rating and slope a negative correlation appeared which would lead to the conclusion that the flatter the surface area, the greater the disease pressure. In a glaciolacustrine type of landscape where the experiment had been set-up, runoff water accumulated on lower lying flatter areas which could increase the incidence of diseases.

A positive correlation between Plant stand and diseases was noticeable which suggested that disease pressure was higher in areas of higher plant density. These findings are similar to those reported by Krupinsky et al (2002) where higher plant stand, high nitrogen levels and high soil moisture levels promoted the growth of canola diseases .

Overall, in 2001management zones had the greatest effect on final yield (43%), followed by weed density (13%), Sclerotinia basal lesions (4%), landscape curvature, field and BlackLeg lesions (3%). All the parameters measured could explain 67% of the yield variability as per the stepwise multiple regression analysis results listed in Table 11.

Table 11. Summary of Stepwise regression to determine the factors that have the greatest effects on yield of canola based on field scaled measurements in 2001.

Variable	P artial R-square	Model R-square	Pr>F
Mgt Zone	0.43	0.43	<.0001
Total Weed Density (# m^{-2})	0.13	0.56	<.0001
Sclerotinia Basal Stem Lesions	0.04	0.60	0.007
Curvature of field	0.02	0.62	0.046
Field on Precision Farm	0.02	0.64	0.034
Blackleg Lesions on Stem	0.02	0.64	0.047
Blackleg Basal Lesions	0.01	0.67	0.13

Year 2002.

The year 2002 was also very dry (Table 6). Beneficial precipitation arrived late in June which affected canola growth. Low available soil moisture and poor seedling emergence had a greater effect on final yield of canola than weeds and disease pressure. Furthermore, swaths suffered extreme wind damage which resulted in dramatic grain loss. Yield maps showed an average of 18 bushels per acre for both fields of canola. For this reason, correlation between yield and other parameters were not looked at for 2002. Only weeds, disease ratings and plant density data were correlated with nitrogen fertility and slope gradient and analysis of variance between means was performed.

Canola plant population was consistent throughout both fields. Plant counts were not affected by management zones and field (Table 12) or by nitrogen rates (Table 13).

Table 12. The effects of field and management zones on the number of plants per meter square in canola in 2002.

Mgt Zone	Field #		Mean
	4	5	
1 (low)	47	56	48
2 (medium)	48	58	56
Mean	48	58	
Mgt Zone ns; Field ns; cv=8.8%			

Table 13. The effects of nitrogen rates and Field on the number of plants per meter square in canola in 2002.

N Rate (kg/ha)	Field #		Mean
	4	5	
0	47	60	
40	49	58	
60	48	58	
90	48	55	
120	47	55	
Mean	48	48	
N rate ns; Field ns; cv=8.8%			

Even though yield losses due to harvest conditions were important, there was a significant yield difference between each management zone as noticed in the past two years (Table 14). This observation concluded that our management zone delineation method developed from Landsat 7 imagery was accurate for a gently undulating, glacio-lacustrine type of landscape.

Table 14. The effects of field and management zones on the grain yield (kg/ha) of canola in 2002.

Mgt Zone	Field #		Mean
	4	5	
1 (low)	854	1124	863
2 (medium)	696	1160	1088
Mean	829	1159	
Mgt Zone **; Field **; cv=13.3%			

Furthermore, nitrogen treatments had a significant negative impact on yields (Table 15) as yields decreased from the lowest to the highest nitrogen rates.

Table 15. The effects of field and Nitrogen rate on the grain yield (kg/ha) of canola in 2002.

N Rate (kg/ha)	Field #		Mean
	4	5	
0	822	1229	1044
40	860	1238	1076
60	867	1187	1027
90	796	1034	887
120	777	1033	872
Mean	829	1159	
N rate **; Field **; cv=13.3%			

Correlation between total weed density and nitrogen fertility were very close to zero which would indicate that nitrogen fertility had no effects on weed density (Table 16). Similar results were found in 2001. However the positive correlation of 0.21 found between weeds and nitrogen fertility in 2000 can be explained by the difference in available moisture in early June of that year.

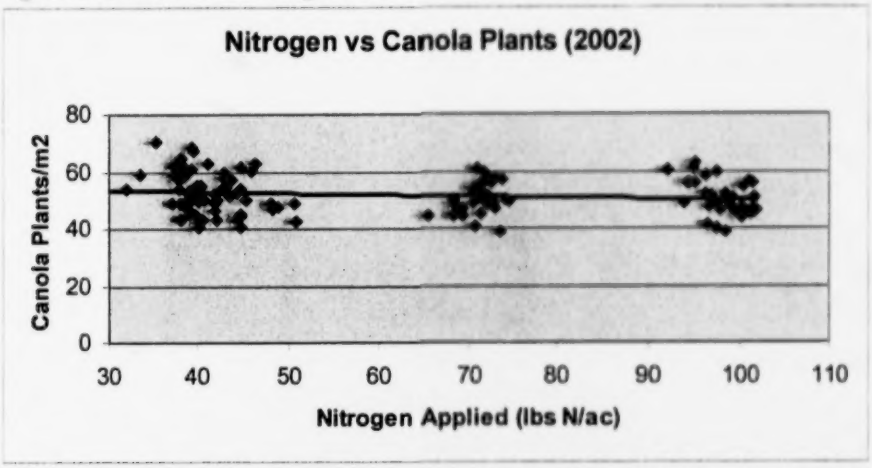
Table 16: 2002 correlation Matrix.

	N fert	Weeds	Plants/m2	HB Rating	Pod Rating	Sclerotinia Stem rating	Sclerotinia Basal rating	BlackLeg Stem rating	Blackleg Basal rating	Slope
N fert	1									
Weeds	0.08	1								
Plants/m2	-0.23*	-0.27*	1							
HB Rating	0.06	0.15*	-0.14*	1						
POD Rating	-0.22*	-0.04	0.28*	0.2	1					
Sclerotinia Stem	0.1	0.13	-0.49*	0.03	-0.31*	1				
Sclerotinia Basal	-0.21*	-0.19*	0.42*	-0.29*	-0.23*	-0.05	1			
BlackLeg Stem	0.01	0.15*	-0.51*	0.27*	-0.05	0.28*	-0.33*	1		
Blackleg Basal	0.15*	0.77*	-0.44*	0.21*	-0.06	0.17*	-0.42*	0.34*	1	
Slope	0.24*	0.02	-0.25*	0.06	-0.07	0.36*	-0.21*	0.06	0.07	1

(* = Correlation significant at the 5% level)

Nitrogen fertility and canola plant density were negatively correlated (-0.23) which would indicate that as nitrogen fertility increased plant density would decrease. This phenomena could be attributed to toxic high residual soil nitrate levels present in the spring due to the 2001 fertilization program that would be detrimental to seedling emergence (Krupinsky et al. (2002)) (Figure 4).

Figure 4: Effects of Nitrogen Treatments on Canola Plant Stand.



Nitrogen treatments had no effects on whole plant Horsfall-Baratt ratings but was negatively correlated to Pod ratings (-0.26). However this interaction was not observed in 2001.

Slope gradient had no effect on weed population, HB and Pod rating as correlation values were near zero. These results emphasize the negative effects of drought conditions on weeds and disease pressure.

Overall in 2002, yields were mostly affected by the difference in field conditions (55%), followed by nitrogen rates (5%), Sclerotinia Basal lesions (4%), Management zones (3%) and other parameters listed in Table 17. From the stepwise multiple regression analysis results acquired, a total of 7% of yield variability could be explained by the parameters (Table 17) which is an improvement from the past 2 years.

Table 17. Summary of Stepwise regression to determine the factors that have the greatest effects on yield of canola based on field scaled measurements in 2002.

Variable	Partial R-square	Model R-square	Pr>F
Field on Precision Farm	0.55	0.55	<.0001
N rate	0.05	0.60	<.0001
Sclerotinia Basal Stem Lesions	0.04	0.64	<.0001
Mgt Zone	0.03	0.67	<.0001
Spotting on Pods	0.01	0.68	0.01
Grassy weeds (# m^{-2})	0.01	0.69	0.049
Blackleg Basal Legions	0.01	0.70	0.03
Curvature of field	0.01	0.71	0.07

Combined year 2001 and 2002.

By pooling the data form 2001 and 2002 we were able to determine the factors that affected yield the most by using a stepwise multiple regression analysis (Table 18). Our results show that 87 % of the yield variability in both years could be explained by 11 variables. The most significant contributing variables to yield variations were year to year differences (69%), followed by Management Zones (10%) and Sclerotinia basal lesions (3%). Surprisingly, N rates only contributed very little to overall yield variability which could be explained by the semi-drought conditions experienced in those years.

Table 18. Summary of Stepwise regression to determine the factors that have the greatest effects on yield of canola based on field scaled measurements over the growing seasons 2001 and 2002.

Variable	P artial R-square	Model R-square	Pr>F
Year	0.69	0.69	<.0001
Mgt Zone	0.10	0.79	<.0001
Sclerotinia Basal stem lesions	0.03	0.82	<.0001
Plants per meter square	0.01	0.83	<.0001
Field on Precision Farm	0.01	0.84	<.0001
Blackleg on Stem	0.01	0.85	.001
Spotting on Pods	0.01	0.85	.001
Grassy weeds (# m^{-2})	0.01	0.86	.001
Curvature of field	0.038	0.86	.001
Broadleaf weeds (# m^{-2})	0.002	0.86	.056
N rate	0.002	0.87	.09

5. Conclusion:

The use of field scale research plots enabled us to quantify the contribution of certain variables to canola final yield. The greatest contributor to yield variability in the past three years was environmental/climate conditions. Differences in yearly precipitation affected the canola yield the most.. The second most important variable was the effects of the management zones. This latest finding emphasized the importance of variable rate fertilization programs based on management zones as yield variability is directly affected by nitrogen rates and management zones potential productivity. The third and fourth variables that played an important role in yield variability were diseases and weeds. This enabled us to conclude that careful crop monitoring for disease and weeds should be done in order to reduce the negative effects these two variables have on canola crops.

The study confirmed that the method developed for assigning management units to a field was accurate, robust and consistent from year to year. This method provides an important tool for producers to learn more about the uniformity of their fields and also to help them be more strategic in how they approach the management of their fields because of the identified zones. It could assist them in their soil sampling.

6. References:

Basnyat, P; Lafond, G.P.; McConkey, B.; Pelcat, Y.; Moulin, A.; 2003 Optimal Time for Remote Sensing Crops by Satellite in the Canadian Prairies; Canadian Journal of Plant Science (accepted)".

Krupinsky, J.M.; Bailey, K.L.; McMullen, M.P., Gossen, B.D. and Turkington, T.K. 2002.Managing Plant Disease Risk in diversified Cropping Systems.Agronomy Journal. 94:198-209

Pennock, D.;Walley, F.; Solohub, M.; Si,B.; Hnatowich, G. 2001.Topographically Controlled Yield response of Canola to nitrogen Fertilizer. Soil Science Society America Journal; 65:1838-1845.

Project #6
Managing Wild Oats In Tame Oats

A. Summary

Not surprisingly, the presence of wild oats decrease the yield of tame oats. Increasing seeding rates lowered the amount of wild oats in the harvested sample and increased yield when wild oats were limiting yield more than the environment. The oats responded to phosphorous but the wild oat biomass was not reduced. I full report should be ready by March 31, 2004

B. Background and Objectives of Study

Approximately 1.5 million acres of oat were harvested for grain in Saskatchewan in 2001. These oat are increasingly being used for human consumption. Over the last five years the capacity to mill these oat in Saskatchewan has increased dramatically with new milling facilities being built in Saskatoon and Yorkton. In addition, 90 to 95% of the oat milled by the Quaker Oats Company in the United States are grown in Canada with a large portion of those oat coming from Saskatchewan. This increased demand has created a premium market for oat. The price decreases as the quality decreases. Minimizing the amount of wild oat and volunteer cereal in oat grain samples is important for oat if they are to meet the specifications of milling and horse feed markets offering premium prices to producers. Improving the management of wild oat in tame oat will improve the profitability of oat producers. In addition, the better wild oat are managed in tame oat the less pressure this weed will place on subsequent crops reducing future costs and use of wild oat herbicides. The objectives of the current oat studies are:

Objectives:

1)to determine if seeding date and seeding rate can affect the competitiveness of oats with wild oats.

2)To determine if phosphorous placed near the seed will increase the competitive ability, quality and yield of tame oat in the presence of wild oat in the field.

C. Study Description

Experiment 1

Wild oats are seeded as early as possible and each seeding date receives an application of glyphosate just before or shortly after seeding.

Strip Split plot with wild oats as the main effect and a two way factorial as the split

Main Plot Size: 77 ft x 13 ft (half of the plot receives wild oats the other half does not with 7 ft pathway mowed in the middle making each plot 13 x 35')

Reps: 4

Main Treatment:

I) Seeding Date:	1) Fall Seeded
	2) Early May
	3) Mid May
	4) Late May

Sub-Plot:

III) Seeding Rate	1) 150 plants m^2
	2) 250 plants m^{-2}
	3) 350 plants m^{-2}

4) 450 plants m^{-2}

Strip Treatment:
I) Wild Oat Density 1) 0 plants m^{-2}
2) 100 plants m^{-2}

Locations: Indian Head, Morden, Saskatoon
Cultivar: AC Pinnacle

Experiment 2:
Strip plot with wild oat as the strip and the subplots will consist of two factors seeding rate and phosphorous, randomized for each rep and seeded across the strips.
Main Plot Size: 77 ft x 13 ft (half of the plot receives wild oats the other half does not with 7 ft pathway mowed in the middle making each plot 13 x 35')
Reps: 4

1) Main plot: I) Phosphorous: 0, 15, and 30 kg ha^{-1} P_2O_5
II) Seeding Rate: 150, 250, 350 and 450 plants m^{-2}
2) Strip -Wild Oat Density: 0 and 50-100 plants m^{-2}

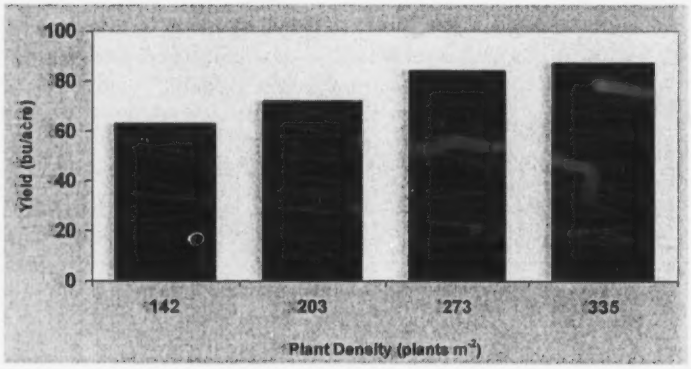
Wild Oats seeded in fall or early spring

Locations: Indian Head
Cultivar: AC Kaufmann

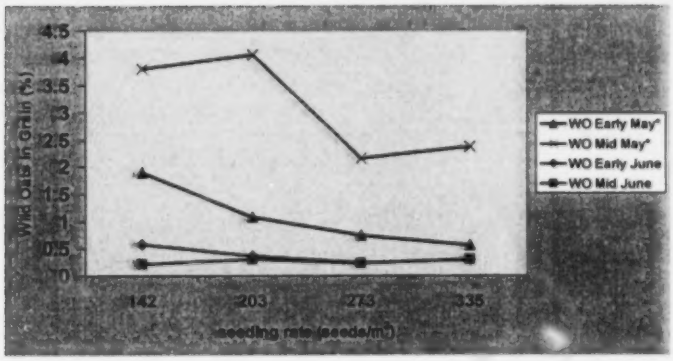
D. Results

This experiment 1 has been conducted for two years with one more year to go. Morden has the highest level of wild oat so data from that sight is presented below.

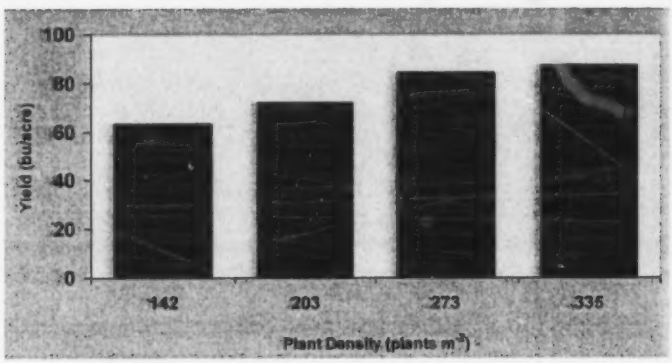
Seeding Rate and Yield
Morden 2003



Wild Oat in Grain
Morden 2003



Seeding Rate and Yield
Morden 2003



Not surprisingly, the presence of wild oat decrease the yield of tame oats. Increasing seeding rates lowered the amount of wild oats in the harvested sample and increased yield when wild oats were limiting yield more than the environment. The oats responded to phosphorous but the wild oat biomass was not reduced. A full report should be ready by March 31, 2004.

E. Indications for Further Research

Current studies must be continued before more research will be recommended.

F. Extension Activities

Results were presented at the Zero Till field day and at the Prairie Oat Growers Association 6th Annual Conference, Nisku, AB, Dec 2th, 2003 and in a IHARF fact sheet entitled "Oat Production: Optimizing Economic Returns".

4) 450 plants m^{-2}

Strip Treatment:
I) Wild Oat Density 1) 0 plants m^{-2}
2) 100 plants m^{-2}

Locations: Indian Head. Morden. Saskatoon
Cultivar: AC Pinnacle

Experiment 2:
Strip plot with wild oat as the strip and the subplots will consist of two factors seeding rate and phosphorous. randomized for each rep and seeded across the strips.
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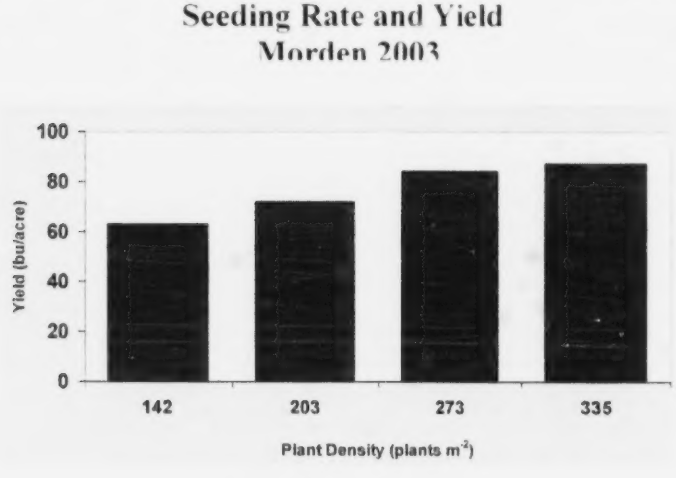
1) Main plot: I) Phosphorous: 0, 15, and 30 kg ha^{-1} P_2O_5
II) Seeding Rate: 150, 250, 350 and 450 plants m^{-2}
2) Strip -Wild Oat Density: 0 and 50-100 plants m^{-2}

Wild Oats seeded in fall or early spring

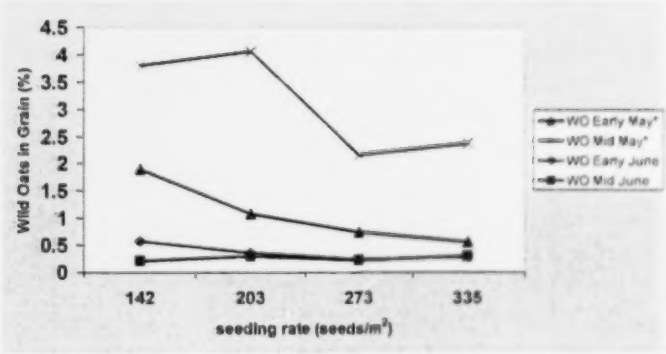
Locations: Indian Head
Cultivar: AC Kaufmann

D. Results

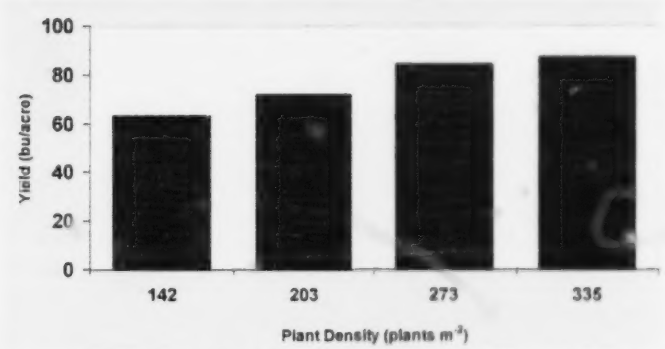
This experiment 1 has been conducted for two years with one more year to go. Morden has the highest level of wild oat so data from that sight is presented below.



Wild Oat in Grain
Morden 2003



Seeding Rate and Yield
Morden 2003



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Project #7
Long-Term vs. Short-Term Effects of No-Till

See Appendix A

3) Personnel

Yann Pelcat – PF Manager – IHARF employee
Chris Omoth – Technician – AAFC employee whose salary is partially paid by IHARF
Bill May – Research Agronomist - AAFC employee whose salary is partially paid by IHARF

4) Equipment

No equipment was purchased with these funds.

5) Project Developed Materials

Field Day Proceedings
Newsletters
Presentations for IHARF Winter Seminar and other meetings.
Factsheets

6) Project Photos

Photos available upon request.

7) Acknowledgements

The SAFRR's support was acknowledged in factsheets, newsletters, signage, proceedings and presentations at field days and meetings and on the website.